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ABSTRACT

A computer project sponsored by a National Science Foundation grant was completed in the psychology department at Loyola University. The purpose of the project was to upgrade existing laboratory equipment in both the operant learning and sensation/perception laboratories, to provide equipment for a cognition laboratory, and to allow increased and more varied opportunities for student research in these areas. Software packages were chosen for their psychology experiment programs as well as their statistical, word processing, and graphics capabilities. The results of this project include: (1) the development of new laboratory courses; (2) an increase in the number of student research projects conducted; (3) the collection and utilization of more complex and detailed data; (4) increased flexibility of lab activities and procedures; and (5) changes in the students' research skill level, comprehension level, and computer expertise, as well as the quality of their projects and presentations. A syllabus for a cognition laboratory course is included. (25 references) (DB)

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Computerized Laboratories in an Undergraduate Psychology Department

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Abstract

A computer project, sponsored by an National Science Foundation grant, was undertaken in an undergraduate psychology department to upgrade lab conditions, expand lab courses, and enhance education and research opportunities of students. Included in this report is a description of the project, its purposes and goals, and the specific results and outcomes. The types of hardware and software purchased and their arrangements for labs in learning, cognition, sensation and perception, and scientific communication are discussed. A sample new course overview and syllabus is also included.

Computerized Laboratories in an Undergraduate Psychology Department

Under a grant from the National Science Foundation, College Science Instrumentation Program (CSI-8750403), a project was undertaken in the Psychology Department of Loyola University in New Orleans to upgrade the psychology laboratories, expand the laboratory courses, and enhance the science education and research opportunities of its students. The purpose of this final report is to detail the purposes and goals, the individual hardware and software purchases, and the specific results and outcomes of this project.

TECHNICAL DESCRIPTION OF PROJECT AND RESULTS:

I. Purpose and Goals

The purpose of this project was to upgrade existing lab equipment in both an operant learning laboratory and a sensation and perception laboratory, to provide equipment for a cognition laboratory, and to provide increased and more varied opportunities for student research in these areas. This project has allowed students to receive first-hand exposure to the concepts, methodology, and instrumentation used in the areas of learning, cognition, and sensation and perception. One of the major goals of the

program was to provide the resources necessary for the development of research skills and the opportunities for independent research. These goals have been successfully met by this project and in many instances the project has gone beyond the original purposes. Details of each aspect of the project and the specific outcomes and results follow.

II. Purchases

Six Zenith computers (IBM compatible) and one MacIntosh computer were purchased. Each of the Zenith computers was equipped with a real time clock and a graphics board. Two of these machines were furnished with 30 mb. hard disk drives; the remaining four had double floppy disk drives. Two machines, one hard disk and one floppy, were equipped with color monitors and color graphics boards. Five Star dot-matrix printers and one Toshiba near-letter-quality printer were purchased for the Zenith computers. The MacIntosh computer was furnished with a hard disk drive and an Apple Imagewriter printer.

Two Zenith microcomputers, one hard disk and one double floppy, were located in the Animal Operant Lab and were devoted to laboratory exercises and research in the area of learning and conditioning. Each computer was interfaced to three existing operant chambers by way of two interfacing systems purchased from Life Sciences Associates (LSA).

These interfacing systems each contained a John Bell I/O board with modifications, a convenience board, a transistor driver board, and appropriate connection cables. A relay board and a triac driver board completed the system. Two Operant_PC software packages were purchased to operate the systems (LSA). In addition, an operant test chamber and test chamber connection panel were purchased to set up a fourth operant station in the Operant Laboratory. This laboratory allows for control of operant chambers, data collection, data analysis and reduction.

Other programs available in the Operant laboratory are: WordPerfect, SPSS/PC+ with the 4 option packages mentioned below, and Turbo Pascal, a programming language. Thus, students in this course and lab may analyze data, prepare reports, and write their own software programs in conditioning and learning.

The Cognition/Sensation and Perception laboratory consists of three double-floppy Zenith microcomputers, two monochrome and one color, and three star dot-matrix printers. These machines were devoted to laboratory section of courses in Cognition and Sensation and Perception as well as independent student research in these areas. Several software packages were purchased which offer a wide variety

of experimental situations. A multiple-copy package of Computer Lab in Memory and Cognition (Conduit) contains eleven programs which allow students to perform some of the classic experiments in cognitive psychology. Computer Programs for Experimental Psychology, Levels 1 and 2 and Discovering Psychology (LSA) increase our lab offerings to well over seventy experiments for both cognition and sensation and perception work. These three packages include experiments as well as response/data analysis capabilities. Some of the options are: pursuit rotor experiments, mirror tracing experiments, latency analyzer, interresponse time analyzer, and event recorder. PC/Lab: PC as a Laboratory Instrument (LSA) is a flexible system which allows for the development of instructor and student experiments. With this package one can use the microcomputers to conduct experiments designed by individuals in our department or replicate/expand the current work of other researchers. An Alpha I/O Digital Input Card, a light pen, and connection cables (LSA) were also purchased to further expand the capabilities of the software packages in this lab.

Several other programs were purchased individually to allow students in lower and upper level courses to participate in demonstrations and experiments and thus encourage them to enroll in the upper level courses and

pursue independent research projects. These programs include (with appropriate area noted): ELIZA (therapy), Operant_Conditioning (learning), RW_Model (learning), MemLab (cognition), Feature_Positive_Effect (sensation and perception), ABI-1.2.3 (learning and cognition).

The final laboratory consisted of one Zenith hard-disk, color microcomputer with a Toshiba near-letter-quality printer and the MacIntosh computer with Imagewriter printer. This lab was devoted to individual and class data analysis, data presentation, report writing, and presentation production. This student workstation, Sci-Com (scientific communication center), allows students to access several statistical, word processing, and graphics packages, as well as production packages specific to some of the psychology programs mentioned above. Word processing packages available include: WordPerfect and Microsoft_Word. The Zenith machine contains the following SPSS/PC+ options: SPSS/PC+, Advanced_Statistics, Graph-in-the-Box, Graphics, Fast_Start. Statmate/Plus, HD_Superstat, Statistical Consultant, and Dyna-Stat_Professional_Statistics_and Graphics were also purchased and installed on this machine to allow students the flexibility to use options unique to each package. Also some of the programs are easier to use

than others, allowing students to learn the more difficult programs gradually.

Programs for the MacIntosh include: MacSS Statistical Software, Cricket Graph, CLR Anova for data analysis, reduction, and presentation. In addition, two packages, MacLaboratory in Psychology and Mindlab, allow students to perform experiments and conduct research demonstrations on the MacIntosh computer.

These purchases have allowed us to greatly improve and expand our existing laboratories, create new laboratories and facilities, offer students a variety of hardware and software options, and provide students with hands-on research experiences. Our decision concerning the software and hardware were based on extensive research and discussion with other departments and universities. Our selections were based largely on ease of use, content validity, variety, and cost. We believe that for our expenditures we have received a wealth of quality hardware and software.

III. Results and Outcomes

Several specific changes in our department and curriculum have resulted directly from the implementation of the equipment purchased from this grant project. The most

obvious concerns the laboratory courses: Animal Operant Lab, Cognition Lab, and Sensation and Perception Lab. In addition, several student research projects have been conducted with this new equipment, two are currently in progress, and several more are planned. More subtle changes involve the research skill level, comprehension level, computer expertise, and quality of projects and presentations of our students.

The Operant Lab course has been completely re-organized. This laboratory, required by students enrolled in the Psychology of Learning course, was seriously underequipped prior to this grant. The acquisition of the new equipment has allowed us to study more complex behavioral phenomena such as discrimination learning and complex reinforcement schedules. It has allowed for the collection and utilization of more detailed data, such as interresponse times and response durations. The lab activities have become more flexible, permitting students to implement different procedures simultaneously rather than being locked into the same procedures continually. The equipment has allowed for increased data collection and analysis, a variety of experimental designs, flexible experimental parameters, and multiple dependent measures. Students are now able to analyze their own individual data

as well as class data and present reports that more closely resemble journal articles. Two independent research projects have been completed in this upgraded laboratory. One student is currently conducting an independent research project, thus bring the total of independent research projects up to three studies involving five senior students over a two year period. This is an appreciable increase in both projects and number of students involved. The previous level was approximately one student, one project, every two years, a limitation due mostly to the inadequacies of the laboratory facilities.

A new laboratory course has been added to our curriculum, Cognition Lab, as an optional component of our Cognition lecture course. The area of Cognition and information processing is one of the most rapidly growing areas of psychology and we are proud to offer such a course at the undergraduate level. The development of a new cognition laboratory has greatly expanded the breath of this aspect of our department. Students are now able to experience directly many of the phenomena and concepts of cognition, memory, and information processing. This area of psychology is one of the more difficult for students to comprehend since the material is often abstract and the research paradigms quite complex. The laboratory has

allowed students to better understand what is being measured, how, and why by participating as subjects and researchers in classical experiments. One student independent research project is currently being completed with the equipment in the Cognition lab. The lab course is now a permanent Spring course offering in our department. Appendix 1 contains the Cognition Lab course syllabus detailing the course requirements and computer assignments. The sensation and perception lab is expected to be offered in the upcoming Spring for the first time in approximately six years.

The Scientific Communication center has given our students the ability to generate reports of a quality that would have been very difficult if not impossible to create previously. Students have used this equipment to analyze the data obtained from laboratory courses in cognition, learning, and physiological psychology as well as courses in comparative, environmental, developmental, and social psychology. The data analysis has been conducted on individual as well as group data and is at a level that students would not have been able to generate without computer assistance. The written reports in courses have improved substantially, incorporating computer generated graphics and illustrations, elaborate data presentations,

and perfectly formatted styles. The content has also improved significantly, mostly as a result of the improved capabilities of the laboratories. Subjectively, it seems that the level of student comprehension has improved and their research interest and skills have increased.

While our original intention was to upgrade our laboratories in order to improve the scientific education of our majors, we have seemingly reached far beyond that initial goal. One-third of the students in the learning lab and cognition lab this academic year were not psychology majors but were from other disciplines. Several students in our lower division courses have been utilizing the equipment before their actual enrollment in the specific upper division courses. We anticipate that this early interest in our computer lab facilities will increase over time and help to promote student interest in psychological research. Hopefully, we will be expanding our use of this equipment to the lower division courses such as Introduction to Research and Statistics.

Faculty research has also been expanded to include assessment of student attitude and attitude change concerning computer use in research and courses. Several research projects are in progress or planned involving

student reactions and use of computers in laboratories and courses. The implementation of this project has resulted in dramatic improvements in the quality and quantity of our courses, our laboratories, and both student and faculty research.

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APPENDIX 1

PSYC 323 - COGNITION LAB Spring, 1990
Credit: 1 hr.

This course will involve structured laboratory experiences in execution, data collection, analysis, and interpretation in traditional and contemporary areas of cognitive psychology. Topics include perception, memory processes, problem solving, and language comprehension.

Course Objectives: The purpose of this course is to familiarize and involve you with the experimental methods used in the behavioral measurement of cognitive processes, the interpretation of data in light of current theories and research, and the written expression of results and conclusions. In addition, this course hopes to promote a deeper understanding of cognitive phenomenon, research methodology, and experimental psychology.

Course Outline: The activities in the lab course are designed to parallel the topics covered in PSYC 322: Cognition. Each week you will be conducting experiments in an area of cognitive psychology, using yourself as a subject. All lab activities involve the use of a computer and software that was designed to present stimuli in a controlled manner, collect data from you, and store class data. The textbook and materials for this course (see below) will provide you with detailed instructions on how to operate the equipment and software for this course. Each experiment will require that you read the theoretical background and the methods and instructions in you lab manual/materials PRIOR to your data collection activity. At the end of the each week, the class data will be complied for your use in interpreting and evaluating the results in lab reports and/or data summary sheets.

Prerequisites: You should either be presently enrolled in PSYC 322 Cognition or have completed that course in a previous semester. You must also have completed the following:

PSYC 100 Introduction to Psychology
PSYC 200 Introduction to Research
PSYC 205 Statistics and Methods

Textbook and Materials: The following laboratory manual was produced explicitly for one of the software packages we will be using in the lab. It is required and may be purchased in the bookstore.

Keenan, J. M., & Keller, R. A. (1987). Computer Lab in Memory and Cognition. Student Manual. Iowa City: Conduit.

There is also a collection of lab materials that you are to purchase from Central Reproduction located on the second floor of Monroe Science Complex. These materials consists of instructions, data sheets, supplemental readings, and lab report questions for those lab exercises not included in the lab manual. You will also need a 5.25" double-sided, double-density floppy disk in order to store your data files for the 3 programs not contained in your lab manual.

Course Requirements and Evaluation: The grade that you receive in this lab course will be based on (1) your weekly lab performance, (2) five brief lab summaries, and (3) three multiple-experiment lab reports. The lab will require approximately one hour of your time per week at the computer, but this hour can be arranged to suit your schedule.

Lab performance will involve conducting your weekly lab activity during a time that has been agreed upon, following the regulations of the lab, and submitting your detailed data sheets at the end of the week. You will also have to give me your floppy disks containing your data files for the 3 experiments not included in your manual. Please note that lab performance is not based on how well you perform on the cognitive tasks but on how well you perform in the research and data collection aspects of the lab activity.

Each of five lab summaries are to present the data (graphs, tables) and briefly summarize the results from one weekly lab activity. You should also provide a brief (1-2 paragraphs) interpretation/discussion of the results. You will probably use the discussion questions provided with the experimental instructions to guide you in these summaries. You do not have to produce a formal Results and Discussion section for these summaries.

At three points in the semester you are required to submit lab reports in APA format, each covering multiple experiments. These reports are to contain

formal Results and Discussion sections. They should be based on the individual and class data, an interpretation of the results, conclusions drawn from these, and the theoretical implications. You are to specifically address the Results and Discussion questions contained in your lab manual for each experiment. However, do not simply answer the questions one after another with no integration of the results and conclusions. While the questions should be addressed, the text should have structure, organization, and cohesiveness. These three reports will cover experiments in Levels of Processing, Encoding Specificity, and Constructive Processes in Prose Comprehension. Since you will participate in more than one experiment on each topic, your lab reports will cover multiple experiments. You will need separate Results sections for each experiment, but you may combine the Discussions into a General Discussion. You could also have a separate Discussion section for each Results section but you would also have to include a General Discussion in order to tie the experiments together. Please note that late reports will have their grade reduced by five points for each day.

The amount of credit you receive for your reports and summaries will be based on the QUALITY of your work. You should demonstrate that you understood what you were doing in the experiment, why you did it, what the results mean, etc. I should not see any of your phrases copied out of the lab manual.

Lab performance will constitute 15% of your grade, lab summaries 25% and the lab reports the remaining 60%. However, please note that if you do not submit your data each week by the due date, it will not be included in the data summaries given to you on Mondays. This will present serious problems when you write your summaries and reports.

Lab Hours: You are to arrange with the instructor during the first week of class your individual lab time. You will need a block of approximately one hour per week during which the computer and appropriate software will be reserved for your use. This hour should be within the normal school day, that is, from approximately 9 am to 5 pm, Monday through Friday. We will meet as a class only during the first week of the semester for an introduction and demonstration in the Cognition Lab (Monroe 473).

Semester Schedule: Below is the semester schedule which contains several pieces of information. Each week a different experiment will be performed by you in the lab. The experiment is to be run at some point during that week, not before or after. Your data printout from the computer is due by 5 pm on Friday; this date is given in the "data due" column. You must have collected your data by 5 pm on Friday. Combined class data will be available for you to pick up the following Monday; that date is shown in the "data available column". You are to use this combined class data for your weekly lab summary or lab reports. Your completed lab report (either the weekly lab summaries or the larger lab reports) is due on the date shown in the "report due" column.
The three large multiple-experiment reports are due on the dates listed. Since these reports are much longer and more involved, it is suggested that you plan to work on them long before the due dates. Note that you will have more time for these reports than you have for the shorter lab summaries.

SEMESTER SCHEDULE

Week#/ week of	Topic/ Experiment	data due	data available	report due
WK 1 1/10	Introduction			
WK 2 1/15	>+Signal Detection (use your data disk)	1/19	1/22	1/29
WK 3 1/22	Levels of Processing 1	1/26	1/29	*2/19
WK 4 1/29	Levels of Processing 2	2/2	2/5	*2/19
WK 5 2/5	>+Sensory Memory (use your data disk)	2/9	2/12	2/19
WK 6 2/12	Encoding Specificity 1	2/16	2/19	**3/26
WK 7 2/19	Encoding Specificity 2	2/23	3/5	**3/26

WK 8 2/26	Mardi Gras Holidays/Spring Break			
WK 9 3/5	Encoding Specificity 3	3/9	3/12	**3/26
WK 10 3/12	>+Retrieval from Working Memory (use your data disk)	3/16	3/19	3/26
WK 11 3/19	Constructive Processes in Prose Comprehension 1	3/23	3/26	***4/23
WK 12 3/26	Constructive Processes in Prose Comprehension 2	3/30	4/2	***4/23
WK 13 4/2	Constructive Processes in Prose Comprehension 3	4/6	4/9	***4/23
WK 14/15 4/9-4/16	Sentence-Picture Verification	4/20	4/23	4/30
WK 16 4/23	Semantic Memory	4/27	4/30	5/7

* Report 1 will consist of multiple Results sections and a Discussion section based on the two LEVELS OF PROCESSING experiments. This report is due on 2/19.

** Report 2 will consist of multiple Results sections and a Discussion section based on the three experiments on ENCODING SPECIFICITY. This report will be due on 3/26.

*** Report 3 will consist of multiple Results sections and a Discussion section based on the three experiments on CONSTRUCTIVE PROCESSES IN PROSE COMPREHENSION. It is due on 4/23.

>+ These experiments are not included in your lab manual but can be found in the materials obtained from Central Reproduction. These also have a different procedure (see below) and you must use your own data disk in drive B. I will not supply a data disk for these programs.

Computer Lab Procedures: Each chapter in your lab manual presents a fairly complete background on the theories and research which gave rise to the original experiment. These background sections set the stage for your experiment. Each chapter also contains a series of discussion questions to provide you with a framework for interpreting the results. They are to be used as a guide for your lab reports and summaries. You must understand the relation between the data and the theory in order to answer them so reading the introductory remarks in each chapter is important. You should read the appropriate chapter in the student manual, stopping when you are told to do so and run the software, participating as a subject in the experiment. You should not read ahead; these experiments are not competitive games and reading ahead will only invalidate your data.

Following the experiment the program will display you data; you are to copy these data onto your data sheets. Then you should read the remaining information in the manual chapter. You are then to write your summaries/reports, using the discussion questions as a guide. These written summaries and reports will serve as an indication of your understanding of the theories and ability to interpret the data. You must turn in your data to me; it will be returned along with the combined class data. Both are to be used for your reports and summaries.

In order to run the software for the experiments in your lab manual, you are to put Disk I in the top slot of the computer, close the latch, and turn the power on at the power strip. The computer will automatically boot and start the Cognition lab program. Put the data disk I give you into the bottom drive slot and close the latch. You will then be asked by the machine to state what program you would like to run. Each program should take less than 1 hour to complete. When the program is finished the screen will display your data which you are to record. You can also at this time press the PrtSc* key on the keyboard (upper row, right side) and the printer will print the screen currently displayed on the monitor. You may take this printer sheet with you, but do not use the platen knob to move the paper forward; this will break the printer. You must use the keys on the printer to advance the paper, deselect and line feed/form feed. You will be asked if you want to store your data. Respond yes. Use your last name as the file name for these data.

You do not have to print out the class summaries. These will be available for you on Mondays.

For the three programs not in your manual, put Disk I into the top slot and your disk into the bottom. At the end of the program you can print your data by using the print option. You do not have to use the PrtSc* method for these 3 programs. You will have to give me your floppy disk with your data file on it. I will return it to you. You will not have to supply a file name in these experiments.